# TFT LCD Approval Specification

# MODEL NO.: N150X3 - L0A

Customer: Lenovo

Approved by: _____

Note:

| Liquid Crystal Display Division | |
|---|---|
| QRA Division. | OA Head Division. |
| Approval | Approval |
| 陳 94.10.25 永一 | 林 94.10.25 添仁 |

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## REVISION HISTORY

| Version | Date | Page (New) | Section | Description |
|---|---|---|---|---|
| Ver 3.0 | Sep.24,'05 | All | All | Approval specification was first issued |

# 1. GENERAL DESCRIPTION

## 1.1 OVERVIEW

N150X3- L09 is a 15.0" TFT Liquid Crystal Display module & ROHS module. This module supports 1024 x 768 XGA mode and can display 262,144 colors. The optimum viewing angle is at 6 o'clock direction.

## 1.2 FEATURES

- Thin and Light Weight
- XGA (1024 x 768 pixels) resolution
- DE only mode
- 3.3V LVDS (Low Voltage Differential Signaling) interface with 1 pixel/clock
- SPWG (Standard Panel Working Group) Style B compatible
- Single CCFL

## 1.3 APPLICATION

- TFT LCD Notebook

## 1.4 GENERAL SPECIFICATI0NS

| Item | Specification | Unit | Note |
|---|---|---|---|
| Active Area | 304.1 (H) x 228.1 (V) (15.0" diagonal) | mm | (1) |
| Bezel Opening Area | 307.8 (H) x 231.6 (V) | mm | |
| Driver Element | a-si TFT active matrix | - | - |
| Pixel Number | 1024 x R.G.B. x 768 | pixel | - |
| Pixel Pitch | 0.297 (H) x 0.297 (V) | mm | - |
| Pixel Arrangement | RGB vertical stripe | - | - |
| Display Colors | 262,144 | color | - |
| Transmissive Mode | Normally white | - | - |
| Surface Treatment | Hardness (2H), Haze 40,Reflection≦3% | - | - |

## 1.5 MECHANICAL SPECIFICATIONS

| Item | | Min. | Typ. | Max. | Unit | Note |
|---|---|---|---|---|---|---|
| Module Size | Horizontal(H) | 316.8 | 317.3 | 317.8 | mm | (1) |
| | Vertical(V) | 241.5 | 242 | 242.5 | mm | (1) |
| | Depth(D) | - | 5.7 | 6.0 | mm | (1) |
| Weight | | - | 500 | 515 | g | - |

Note (1) Please refer to the attached drawings for more information of front and back outline dimensions.

## 2. ABSOLUTE MAXIMUM RATINGS

### 2.1 ABSOLUTE RATINGS OF ENVIRONMENT

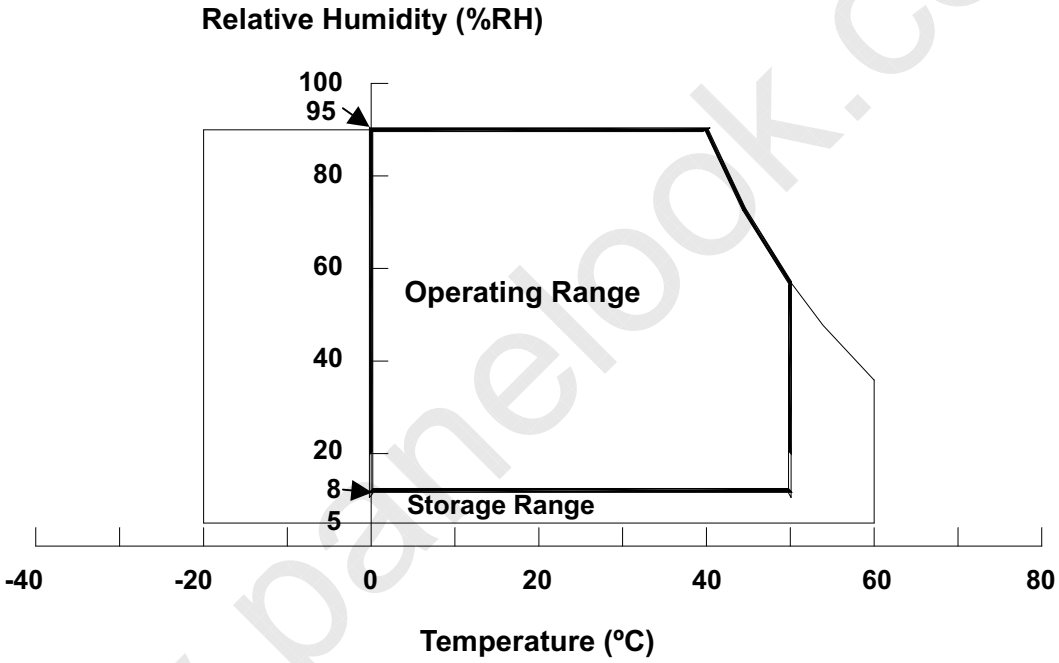
| Item | Symbol | Value | | Unit | Note |
|---|---|---|---|---|---|
| | | Min. | Max. | | |
| Storage Temperature | $T_{ST}$ | -20 | +60 | ºC | (1) |
| Operating Ambient Temperature | $T_{OP}$ | 0 | +50 | ºC | (1), (2) |
| Shock (Non-Operating) | $S_{NOP}$ | - | **210** | **G** | **(3), (5)** |
| Vibration (Non-Operating) | $V_{NOP}$ | - | 1.5 | G | (4), (5) |

Note (1) Temperature and relative humidity range is shown in the figure below.

(a) RH ≦95 %. (Ta ≦ 40 ºC)

(b) Wet-bulb temperature should be 39 ºC Max. (Ta > 40 ºC).

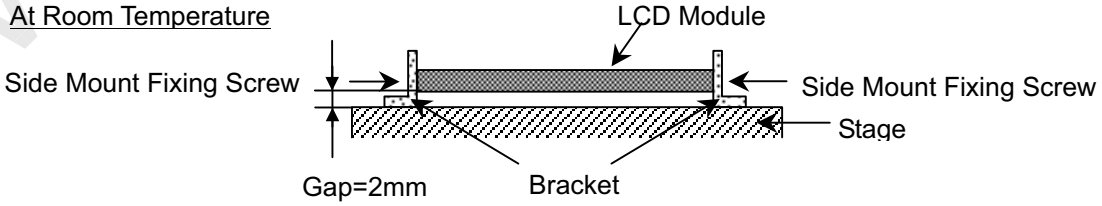
(c) No condensation .




Note (2) The temperature of panel surface should be 0 ºC Min. and 50 ºC Max.

Note (3) 3ms, half sine wave, 1 time for ± X, ± Y, ± Z.

Note (4) 10 ~ 200 Hz, 0.5 Hr / Cycle, 1 cycles for each X, Y, Z. The fixing condition is shown as below:




Note (5) At testing Vibration and Shock, the fixture in holding the module has to be hard and rigid enough so that the module would not be twisted or bent by the fixture.

### 2.2 ELECTRICAL ABSOLUTE RATINGS

#### 2.2.1 TFT LCD MODULE

| Item | Symbol | Value | | Unit | Note |
|---|---|---|---|---|---|
| | | Min. | Max. | | |
| Power Supply Voltage | $V_{CC}$ | -0.3 | +4.0 | V | (1) |
| Logic Input Voltage | $V_{IN}$ | -0.3 | $V_{CC}$+0.3 | V | |

#### 2.2.2 BACKLIGHT UNIT

| Item | Symbol | Value | | Unit | Note |
|---|---|---|---|---|---|
| | | Min. | Max. | | |
| Lamp Voltage | $V_L$ | - | 2.5K | $V_{RMS}$ | (1), (2), $I_L$ = 6.0 mA |
| Lamp Current | $I_L$ | 2 | 7 | $mA_{RMS}$ | (1), (2) |
| Lamp Frequency | $F_L$ | 45 | 80 | KHz | |

Note (1) Permanent damage to the device may occur if maximum values are exceeded. Function operation should be restricted to the conditions described under Normal Operating Conditions.

Note (2) Specified values are for lamp (Refer to 3.2 for further information).

## 3. ELECTRICAL CHARACTERISTICS

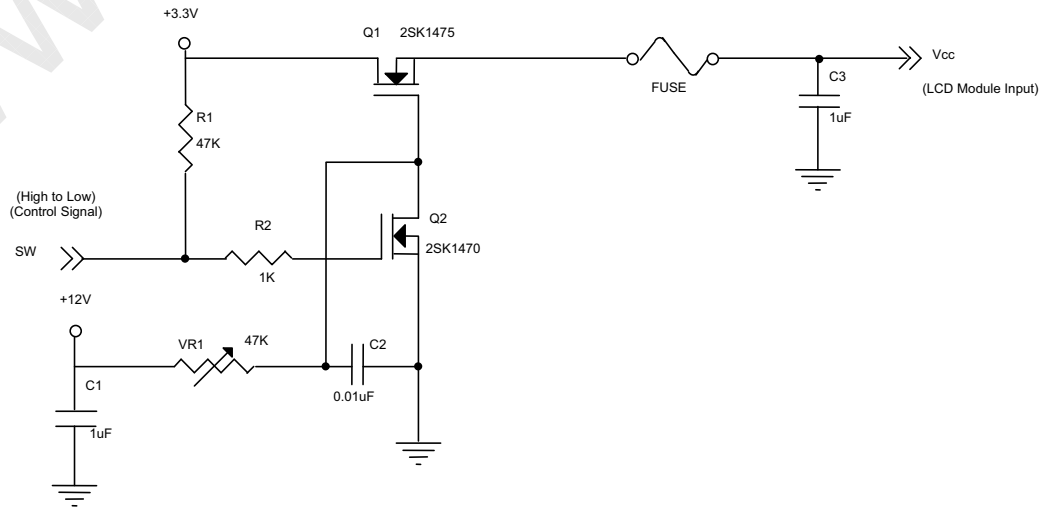
### 3.1 TFT LCD MODULE

Ta = 25 ± 2 ºC

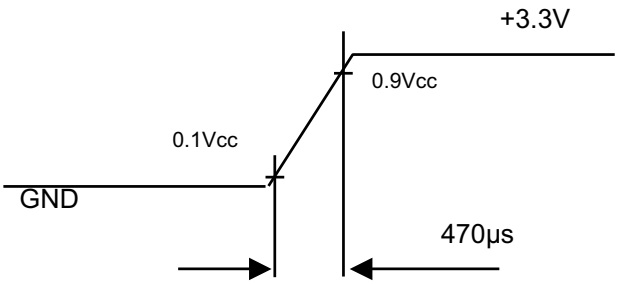
| Parameter | | Symbol | Value | | | Unit | Note |
|---|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | | |
| Power Supply Voltage | | Vcc | 3.0 | 3.3 | 3.6 | V | - |
| Ripple Voltage | | $V_{RP}$ | - | 100 | - | mV | - |
| Rush Current | | $I_{RUSH}$ | - | - | 1.5 | A | (2) |
| Power Supply Current | White | Lcc | - | 300 | 350 | mA | (3)a |
| | Black | | - | 350 | 400 | mA | (3)b |
| Logical Input Voltage (LVDS) | "H" Level | $V_{IL}$ | - | - | +100 | mV | - |
| | "L" Level | $V_{IH}$ | -100 | - | - | mV | - |
| Terminating Resistor | | $R_T$ | - | 100 | - | Ohm | - |
| Power per EBL WG | | $P_{EBL}$ | - | 3.176 | - | W | (4) |

Note (1) The module should be always operated within above ranges.

Note (2) Measurement Conditions:



**Vcc rising time is 470µs**




Note (3) The specified power supply current is under the conditions at Vcc = 3.3 V, Ta = 25 ± 2 ºC, $f_v$ = 60 Hz, whereas a power dissipation check pattern below is displayed.

a. White Pattern

Active Area

b. Black Pattern

Active Area

Note (4) The specified power are the sum of LCD panel electronics input power and the inverter input power. Test conditions are as follows.

(a) Vcc = 3.3 V, Ta = 25 ± 2 ºC, $f_v$ = 60 Hz,

(b) The pattern used is a black and white 32 x 36 checkerboard, slide #100 from the VESA file "Flat Panel Display Monitor Setup Patterns", FPDMSU.ppt.

(c) Luminance: 60 nits.

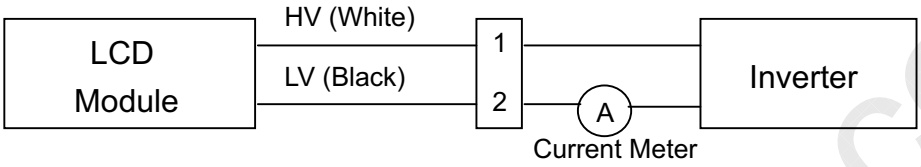
(d) The inverter used is provided from O2Micro (www.o2micro.com). Please contact O2Mirco for detail information. CMO doesn't provide the inverter in this product.

## 3.2 BACKLIGHT UNIT

Ta = 25 ± 2 ºC

| Parameter | Symbol | Value | | | Unit | Note |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Lamp Input Voltage | $V_L$ | 627 | 660 | 693 | $V_{RMS}$ | $I_L$ = 6.0 mA |
| Lamp Current | $I_L$ | 2.0 | 6.0 | 6.5 | $mA_{RMS}$ | (1) |
| Lamp Turn On Voltage | $V_S$ | --- | --- | 1110 (25 °C) | $V_{RMS}$ | (2) |
| | | --- | --- | 1330 (0 °C) | $V_{RMS}$ | (2) |
| Operating Frequency | $F_L$ | 45 | 60 | 80 | KHz | (3) |
| Lamp Life Time | $L_{BL}$ | 15000 | --- | - | Hrs | (5) |
| Power Consumption | $P_L$ | - | 3.96 | - | W | (4), $I_L$ = 6.0 mA |

Note (1) Lamp current is measured by utilizing a high frequency current meter as shown below:




Note (2) The voltage shown above should be applied to the lamp for more than 1 second after startup. Otherwise the lamp may not be turned on.

Note (3) The lamp frequency may produce interference with horizontal synchronous frequency from the display, and this may cause line flow on the display. In order to avoid interference, the lamp frequency should be detached from the horizontal synchronous frequency and its harmonics as far as possible.

Note (4) $P_L = I_L \times V_L$

Note (5) The lifetime of lamp can be defined as the time in which it continues to operate under the condition Ta = 25 ±2 °C and $I_L$ = 6.0 mArms until one of the following events occurs:

(a) When the brightness becomes or lower than 50% of its original value.

(b) When the effective ignition length becomes or lower than 80% of its original value. (Effective ignition length is defined as an area that has less than 70% brightness compared to the brightness in the center point.)

Note (6) The waveform of the voltage output of inverter must be area-symmetric and the design of the inverter must have specifications for the modularized lamp. The performance of the Backlight, such as lifetime or brightness, is greatly influenced by the characteristics of the DC-AC inverter for the lamp. All the parameters of an inverter should be carefully designed to avoid producing too much current leakage from high voltage output of the inverter. When designing or ordering the inverter please make sure that a poor lighting caused by the mismatch of the Backlight and the inverter (miss-lighting, flicker, etc.) never occurs. If the above situation is confirmed, the module should be operated in the same manners when it is installed in your instrument.

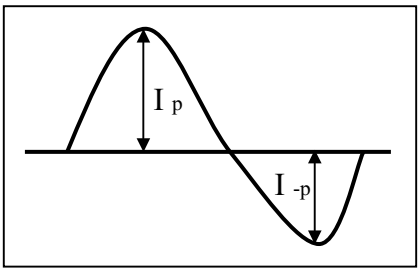
The output of the inverter must have symmetrical (negative and positive) voltage waveform and symmetrical current waveform.(Unsymmetrical ratio is less than 10%) Please do not use the inverter which has unsymmetrical voltage and unsymmetrical current and spike wave. Lamp frequency may produce interface with horizontal synchronous frequency and as a result this may cause beat on the display. Therefore lamp frequency shall be as away possible from the horizontal synchronous frequency and from its harmonics in order to prevent interference.

Requirements for a system inverter design, which is intended to have a better display performance, a better power efficiency and a more reliable lamp. It shall help increase the lamp lifetime and reduce its leakage current.

a. The asymmetry rate of the inverter waveform should be 10% below;

b. The distortion rate of the waveform should be within $\sqrt{2} \pm 10\%$;

The ideal sine wave form shall be symmetric in positive and negative polarities.




* Asymmetry rate:

$| I_p - I_{-p} | / I_{rms} * 100\%$

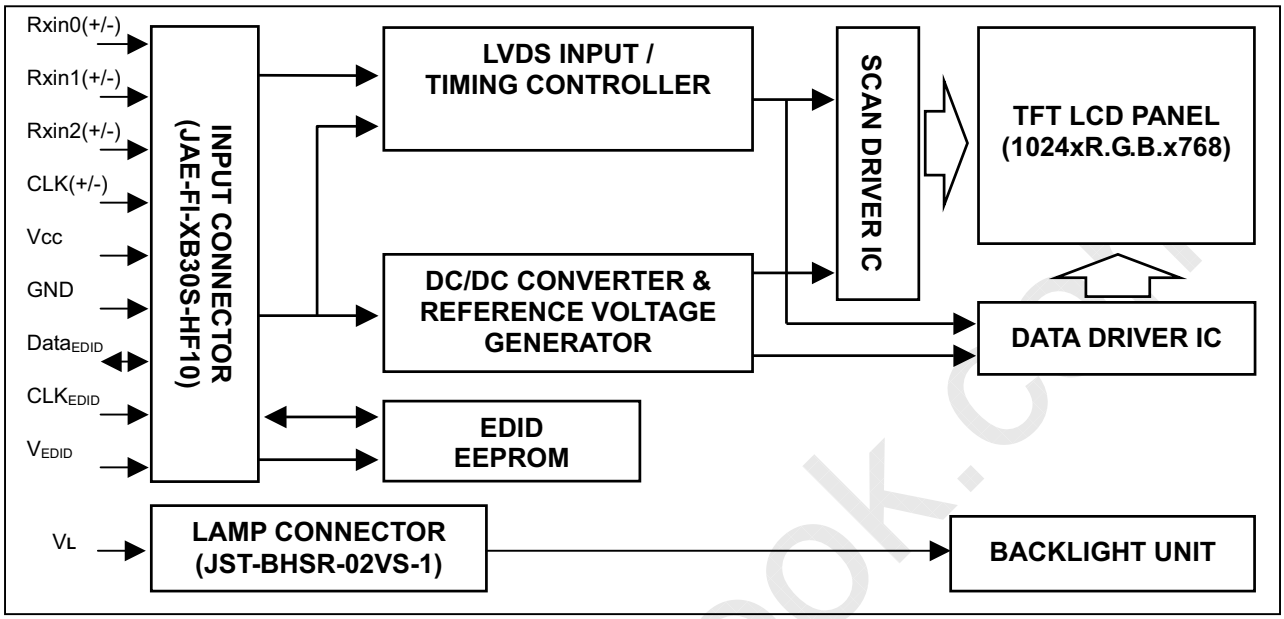
* Distortion rate

$I_p$ (or $I_{-p}$) / $I_{rms}$

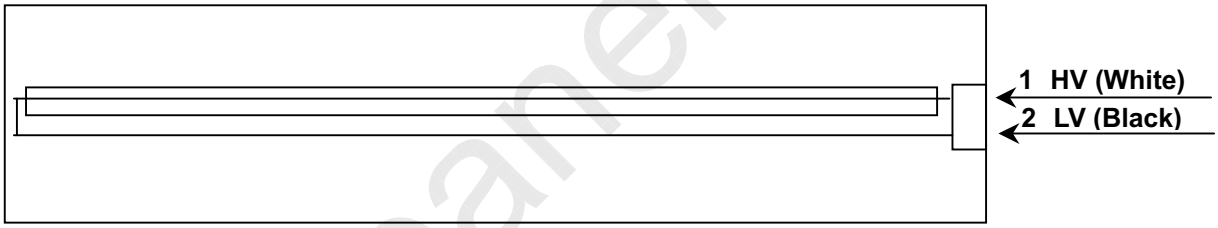
# 4. BLOCK DIAGRAM

TFT LCD MODULE

## 4.1 TFT LCD MODULE




## 4.2 BACKLIGHT UNIT



## 5. INPUT TERMINAL PIN ASSIGNMENT

### 5.1 TFT LCD MODULE

| Pin | Symbol | Description | Polarity | Remark |
|---|---|---|---|---|
| 1 | Vss | Ground | | |
| 2 | Vcc | Power Supply +3.3 V (typical) | | |
| 3 | Vcc | Power Supply +3.3 V (typical) | | |
| 4 | $V_{EDID}$ | DDC 3.3V Power | | DDC 3.3V Power |
| 5 | NC | Non-Connection | | |
| 6 | $CLK_{EDID}$ | DDC Clock | | DDC Clock |
| 7 | $DATA_{EDID}$ | DDC Data | | DDC Data |
| 8 | Rxin0- | LVDS Differential Data Input | Negative | R0~R5,G0 |
| 9 | Rxin0+ | LVDS Differential Data Input | Positive | - |
| 10 | Vss | Ground | | |
| 11 | Rxin1- | LVDS Differential Data Input | Negative | G1~G5,B0,B1 |
| 12 | Rxin1+ | LVDS Differential Data Input | Positive | - |
| 13 | Vss | Ground | | |
| 14 | Rxin2- | LVDS Differential Data Input | Negative | B2~B5,DE,Hsync,Vsync |
| 15 | Rxin2+ | LVDS Differential Data Input | Positive | |
| 16 | Vss | Ground | | |
| 17 | CLK- | LVDS Clock Data Input | Negative | LVDS Level Clock |
| 18 | CLK+ | LVDS Clock Data Input | Positive | |
| 19 | Vss | Ground | | |
| 20 | NC | Non-Connection | | |
| 21 | NC | Non-Connection | | |
| 22 | Vss | Ground | | |
| 23 | NC | Non-Connection | | |
| 24 | NC | Non-Connection | | |
| 25 | Vss | Ground | | |
| 26 | NC | Non-Connection | | |
| 27 | NC | Non-Connection | | |
| 28 | Vss | Ground | | |
| 29 | NC | Non-Connection | | |
| 30 | NC | Non-Connection | | |

Note (1) Connector Part No.: JAE-FI-XB30SL-HF10

Note (2) User's connector Part No: JAE-FI-X30C2L

Note (3) The first pixel is even.

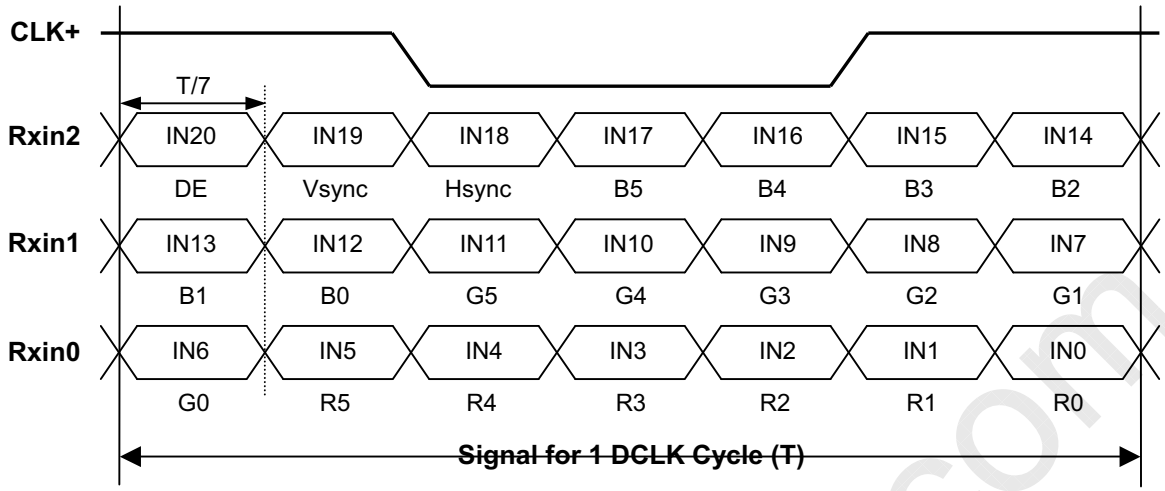
### 5.2 BACKLIGHT UNIT

| Pin | Symbol | Description | Color |
|---|---|---|---|
| 1 | HV | High Voltage | White |
| 2 | LV | Ground | Black |

Note (1) Connector Part No.: JST-BHSR-02VS-1

Note (2) User's connector Part No.: JST-SM02B-BHSS-1-TB

5.3 TIMING DIAGRAM OF LVDS INPUT SIGNAL



## 5.4 EDID DATA

The EDID (Extended Display Identification Data) data formats are to support displays as defined in the VESA Plug & Display and FPDI standards.

| Byte # (decimal) | Byte #(hex) | Field Name and Comments | Value (hex) | Value (binary) |
|---|---|---|---|---|
| 0 | 0 | Header , Fixed | 00 | 00000000 |
| 1 | 1 | Header , Fixed | FF | 11111111 |
| 2 | 2 | Header , Fixed | FF | 11111111 |
| 3 | 3 | Header , Fixed | FF | 11111111 |
| 4 | 4 | Header , Fixed | FF | 11111111 |
| 5 | 5 | Header , Fixed | FF | 11111111 |
| 6 | 6 | Header , Fixed | FF | 11111111 |
| 7 | 7 | Header , Fixed | 00 | 00000000 |
| 8 | 8 | ID=IBM | 30 | 00100100 |
| 9 | 9 | ID=IBM | AE | 01001101 |
| 10 | 0A | XGA (IBM Unique ID) | 40 | 01010101 |
| 11 | 0B | XGA (IBM Unique ID) | 40 | 00001010 |
| 12 | 0C | 32-bit serial # Unused(01h for VESA, 00h for SPWG) | 00 | 00000000 |
| 13 | 0D | 32-bit serial # Unused(01h for VESA, 00h for SPWG) | 00 | 00000000 |
| 14 | 0E | 32-bit serial # Unused(01h for VESA, 00h for SPWG) | 00 | 00000000 |
| 15 | 0F | 32-bit serial # Unused(01h for VESA, 00h for SPWG) | 00 | 00000000 |
| 16 | 10 | Week of manufacture 1 - 53 (unused: 00h) | 00 | 00000000 |
| 17 | 11 | Year of manufacture year - 1990(unsed:00h) | 00 | 00000000 |
| 18 | 12 | Version=1 | 01 | 00000001 |
| 19 | 13 | Revision=3 | 03 | 00000011 |
| 20 | 14 | Digital | 80 | 10000000 |
| 21 | 15 | Active area horizontal 30.4128 cm | 1E | 00011110 |
| 22 | 16 | Active area vertical 22.8096cm | 17 | 00010111 |
| 23 | 17 | gamma * 100-100 = 2.2*100-100=120 | 78 | 01111000 |
| 24 | 18 | Feature support (no DPMS, Active off, RGB, Preferred Timing Mode) | EA | 00001010 |
| 25 | 19 | Rx1 Rx0 Ry1 Ry0 Gx1 Gx0 Gy1 Gy0 | 77 | 01110111 |
| 26 | 1A | Bx1 Bx0 By1 By0 Wx1 Wx0 Wy1 Wy0 | F1 | 11110001 |
| 27 | 1B | Rx=0.626 | A0 | 10100000 |
| 28 | 1C | Ry=0.355 | 5A | 01011010 |
| 29 | 1D | Gx=0.294 | 4B | 01001011 |
| 30 | 1E | Gy=0.589 | 96 | 10010110 |
| 31 | 1F | Bx=0.144 | 24 | 00100100 |
| 32 | 20 | By=0.097 | 18 | 00011000 |
| 33 | 21 | Wx=0.313 | 50 | 01010000 |
| 34 | 22 | Wy=0.329 | 54 | 01010100 |
| 35 | 23 | Established timings 1 | 21 | 00000000 |
| 36 | 24 | Established timings 2 (1024x768@60Hz) | 08 | 00001000 |
| 37 | 25 | No manufacturer's specific timing | 00 | 00000000 |
| 38 | 26 | Standard timing ID # 1 | 01 | 00000001 |
| 39 | 27 | Standard timing ID # 1 | 01 | 00000001 |
| 40 | 28 | Standard timing ID # 2 | 01 | 00000001 |

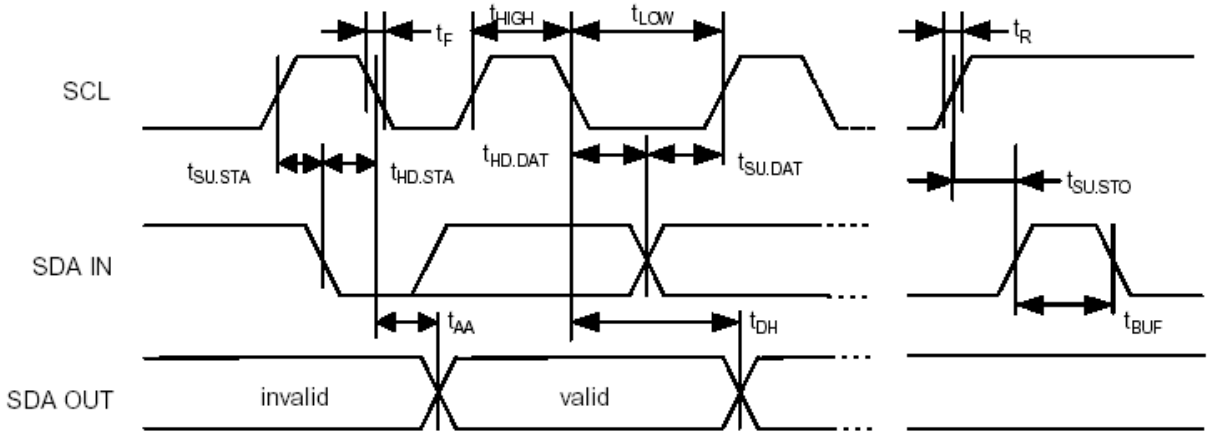
| | | | | |
|---|---|---|---|---|
| 41 | 29 | Standard timing ID # 2 | 01 | 00000001 |
| 42 | 2A | Standard timing ID # 3 | 01 | 00000001 |
| 43 | 2B | Standard timing ID # 3 | 01 | 00000001 |
| 44 | 2C | Standard timing ID # 4 | 01 | 00000001 |
| 45 | 2D | Standard timing ID # 4 | 01 | 00000001 |
| 46 | 2E | Standard timing ID # 5 | 01 | 00000001 |
| 47 | 2F | Standard timing ID # 5 | 01 | 00000001 |
| 48 | 30 | Standard timing ID # 6 | 01 | 00000001 |
| 49 | 31 | Standard timing ID # 6 | 01 | 00000001 |
| 50 | 32 | Standard timing ID # 7 | 01 | 00000001 |
| 51 | 33 | Standard timing ID # 7 | 01 | 00000001 |
| 52 | 34 | Standard timing ID # 8 | 01 | 00000001 |
| 53 | 35 | Standard timing ID # 8 | 01 | 00000001 |
| 54 | 36 | Detailed timing description # 1 Pixel clock (“65MHz”) | 64 | 01100100 |
| 55 | 37 | 65MHz/10000 =6500=1964H | 19 | 00011001 |
| 56 | 38 | HActive(D7-D0) = 1024 mod 256 | 00 | 00000000 |
| 57 | 39 | HBlank(D7-D0) = 320 mod 256 | 40 | 01000000 |
| 58 | 3A | HActive(D11-D8) : HBlank(D11-D8) = 1024/256 : 320/256 | 41 | 01000001 |
| 59 | 3B | VActive(D7-D0) = 768 mod 256 | 00 | 00000000 |
| 60 | 3C | VBlank(D7-D0) = 38 mod 256 | 26 | 00100110 |
| 61 | 3D | VActive(D11-D8) : VBlank(D11-D8) = 768/256 : 38/256 | 30 | 00110000 |
| 62 | 3E | HSyncOffset(D7-D0) = HBorder+HFrontPorch = 24 | 18 | 00011000 |
| 63 | 3F | HSyncWidth(D7-D0) = 136 | 88 | 10001000 |
| 64 | 40 | VSyncOffset(D3-D0)=3 : VSyncWidth(D3-D0)=6 | 36 | 00110110 |
| 65 | 41 | HSyncOffset(D9-D8) : HSyncWidth(D9-D8) : VSyncOffset(D5-D4) : VSyncWidth(D5-D4) | 00 | 00000000 |
| 66 | 42 | HImageSize(mm, D7-D0) = 304mod 256 | 30 | 00110000 |
| 67 | 43 | VImageSize(mm, D7-D0) = 228mod 256 | E4 | 11100100 |
| 68 | 44 | HImageSize(D11-D8) : VImageSize(D11-D8) = 304/256 : 228/256 | 10 | 00010000 |
| 69 | 45 | Horizontal Border=0 | 00 | 00000000 |
| 70 | 46 | Vertical Border=0 | 00 | 00000000 |
| 71 | 47 | Non-interlaced, Normal Display, Digital separate, Positive Hsync, Negative Vsync | 18 | 00011000 |
| 72 | 48 | Detailed timing description # 1 Pixel clock (“54.16MHz”) | 28 | 01010000 |
| 73 | 49 | 54.16MHz/10000 =5416=1528H | 15 | 00010100 |
| 74 | 4A | HActive(D7-D0) = 1024 mod 256 | 00 | 00000000 |
| 75 | 4B | HBlank(D7-D0) = 320 mod 256 | 40 | 00100000 |
| 76 | 4C | HActive(D11-D8) : HBlank(D11-D8) = 1024/256 : 320/256 | 41 | 01000001 |
| 77 | 4D | Vertical Avtive =768 mod 256 | 00 | 00000000 |
| 78 | 4E | Vertical Blanking =38 mod 256 | 26 | 00011001 |
| 79 | 4F | VActive(D11-D8) : VBlank(D11-D8) = 768/256 : 38/256 | 30 | 00110000 |
| 80 | 50 | HSyncOffset(D7-D0) = HBorder+HFrontPorch = 24 | 18 | 00101000 |
| 81 | 51 | HSyncWidth(D7-D0) = 136 | 88 | 01101000 |
| 82 | 52 | VSyncOffset(D3-D0)=3 : VSyncWidth(D3-D0)=6 | 36 | 00110100 |
| 83 | 53 | Horizontal Vertical Sync Offset/Width upper 2bits = 0 | 00 | 00000000 |
| 84 | 54 | HImageSize(mm, D7-D0) = 304mod 256 | 30 | 00011101 |
| 85 | 55 | VImageSize(mm, D7-D0) = 228mod 256 | E4 | 11010110 |

| | | | | |
|---|---|---|---|---|
| 86 | 56 | HImageSize(D11-D8) : VImageSize(D11-D8) = 304/256 : 228/256 | 10 | 00010000 |
| 87 | 57 | Horizontal Border=0 | 00 | 00000000 |
| 88 | 58 | Vertical Border=0 | 00 | 00000000 |
| 89 | 59 | Non-interlaced,Normal display,no stereo,Digital separate sync,H/V pol negatives | 18 | 00011000 |
| 90 | 5A | Flag | 00 | 00000000 |
| 91 | 5B | Flag | 00 | 00000000 |
| 92 | 5C | Flag | 00 | 00000000 |
| 93 | 5D | Data type tag :0F | 0F | 00001111 |
| 94 | 5E | Flag | 00 | 00000000 |
| 95 | 5F | Low Refresh Rate #1 (Horizontal active pixels / 8 ) - 31=97(61h) | 61 | 01100001 |
| 96 | 60 | Low Refresh Rate #1 Image Aspect ratio(4 : 3) | 43 | 01000011 |
| 97 | 61 | Low Refresh Rate #1 Refresh Rate=50Hz | 32 | 00110010 |
| 98 | 62 | Low Refresh Rate #2 (Horizontal active pixels / 8 ) - 31=97(61h) | 61 | 01100001 |
| 99 | 63 | Low Refresh Rate #2 Image Aspect ratio(4 : 3) | 43 | 01000011 |
| 100 | 64 | Low Refresh Rate #2 Refresh Rate=40Hz | 28 | 00101000 |
| 101 | 65 | Brightness (1/10nit) , 200/10=20(=14h) | 14 | 00010100 |
| 102 | 66 | Feature Flags | 01 | 00000001 |
| 103 | 67 | Reserved | 00 | 00000000 |
| 104 | 68 | EISA manufacturer code(3 Character ID) -CMO | 0D | 00001101 |
| 105 | 69 | Compressed ASCII | AF | 10101111 |
| 106 | 6A | Panel Supplier Reserved - Product code -1512 | 12 | 00010010 |
| 107 | 6B | (Hex, LSB first) | 15 | 00010101 |
| 108 | 6C | Flag | 00 | 00000000 |
| 109 | 6D | Flag | 00 | 00000000 |
| 110 | 6E | Flag | 00 | 00000000 |
| 111 | 6F | Data type tag : FEh | FE | 11111110 |
| 112 | 70 | Flag | 00 | 00000000 |
| 113 | 71 | "N" | 4E | 01001110 |
| 114 | 72 | "1" | 31 | 00110001 |
| 115 | 73 | "5" | 35 | 00110101 |
| 116 | 74 | "0" | 30 | 00110000 |
| 117 | 75 | "X" | 58 | 01011000 |
| 118 | 76 | "3" | 33 | 00110011 |
| 119 | 77 | "-" | 2D | 00101101 |
| 120 | 78 | "L" | 4C | 01001100 |
| 121 | 79 | "0" | 30 | 00110000 |
| 122 | 7A | "A" | 41 | 01000001 |
| 123 | 7B | (If <13 char, then terminate with ASCII code 0Ah, set remaining char = 20h) | 0A | 00001010 |
| 124 | 7C | (If <13 char, then terminate with ASCII code 0Ah, set remaining char = 20h) | 20 | 00100000 |
| 125 | 7D | (If <13 char, then terminate with ASCII code 0Ah, set remaining char = 20h) | 20 | 00100000 |
| 126 | 7E | No extension | 00 | 00000000 |
| 127 | 7F | One-byte checksum of entire 128 bytes EDID equals 00h. | 5B | 01011011 |

## 5.5 EDID SIGINAL SPECIFICATION

(1) EDID Power

| Parameter | Symbol | Test Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Power supply voltage | Vcc | — | 2.7 | — | 5.5 | V |




(2) DC characteristics

| Parameter | Symbol | Test Condition | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Supply current Vcc=5.0V | Icc | READ at 100kHz | — | 0.4 | 1.0 | mA |
| Supply current Vcc=5.0V | Icc | WRITE at 100kHz | — | 2.0 | 3.0 | mA |
| Standby Current | ISB | Vin=Vcc or Vss | — | 1.6 | 4.0 | μA |
| Input Leakage Current | ILI | Vin=Vcc or Vss | — | 0.1 | 3.0 | μA |
| Onput Leakage Current | ILO | Vout=Vcc or Vss | — | 0.05 | 3.0 | μA |
| Input Low Level | VIL | — | -1.0 | — | Vcc x 0.3 | V |
| Input High Level | VIH | — | Vcc x 0.7 | — | Vcc+0.5 | V |
| Output Low Level Vcc=1.8V | VOL1 | IOL=0.15mA | — | — | 0.2 | V |
| Output Low Level Vcc=3.0V | VOL2 | IOL=2.1mA | — | — | 0.4 | V |

(3) AC characteristics (VCC=2.5~5.5V standard operation mode)

| Parameter | Symbol | Min | Max | Unit |
|---|---|---|---|---|
| Clock Frequency, SCL | FSCL | — | 100 | kHz |
| Clock Pulse Width Low | TLOW | 4.7 | — | μs |
| Clock Pulse Width High | THIGH | 4.0 | — | μs |
| Noise Suppression Time | TI | — | 100 | ns |
| Clock Low to Data Out Valid | TAA | 0.1 | 4.5 | μs |
| Time the bus must be free before a new transmission can start | TBUF | 4.7 | — | μs |
| Start Hold Time | THD.STA | 4.0 | — | μs |
| Start Set-up Time | TSU.STA | 4.7 | — | μs |
| Data in Hold Time | THD.DAT | 0 | — | μs |
| Data in Set-up Time | TSU.DAT | 200 | — | ns |
| Inputs Rise Time | TR | — | 1.0 | μs |
| Inputs Fall Time | TF | — | 300 | ns |
| Stop Set-up Time | TSU.STO | 4.7 | — | μs |
| Data Out Hold Time | TDH | 100 | — | ns |
| Write Cycle Time | TWR | — | 10 | ms |

## 5.6 COLOR DATA INPUT ASSIGNMENT

The brightness of each primary color (red, green and blue) is based on the 6-bit gray scale data input for the color. The higher the binary input, the brighter the color. The table below provides the assignment of color versus data input.

| Color | | Data Signal | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Red | | | | | | Green | | | | | | Blue | | | | | |
| | | R5 | R4 | R3 | R2 | R1 | R0 | G5 | G4 | G3 | G2 | G1 | G0 | B5 | B4 | B3 | B2 | B1 | B0 |
| Basic Colors | Black | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Blue | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Cyan | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Magenta | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Yellow | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | White | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Gray Scale Of Red | Red(0)/Dark | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red(1) | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red(2) | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : |
| | Red(61) | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red(62) | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red(63) | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gray Scale Of Green | Green(0)/Dark | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(1) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(2) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : |
| | Green(61) | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(62) | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(63) | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gray Scale Of Blue | Blue(0)/Dark | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Blue(1) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| | Blue(2) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : |
| | Blue(61) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 |
| | Blue(62) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 |
| | Blue(63) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |

Note (1) 0: Low Level Voltage, 1: High Level Voltage

# 6. INTERFACE TIMING

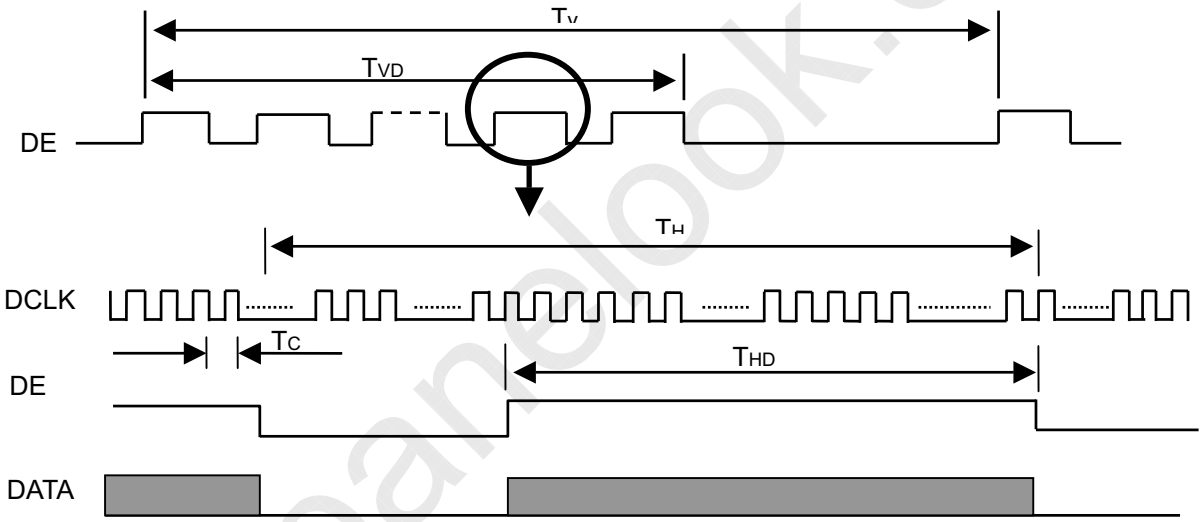
## 6.1 INPUT SIGNAL TIMING SPECIFICATIONS

The input signal timing specifications are shown as the following table and timing diagram.

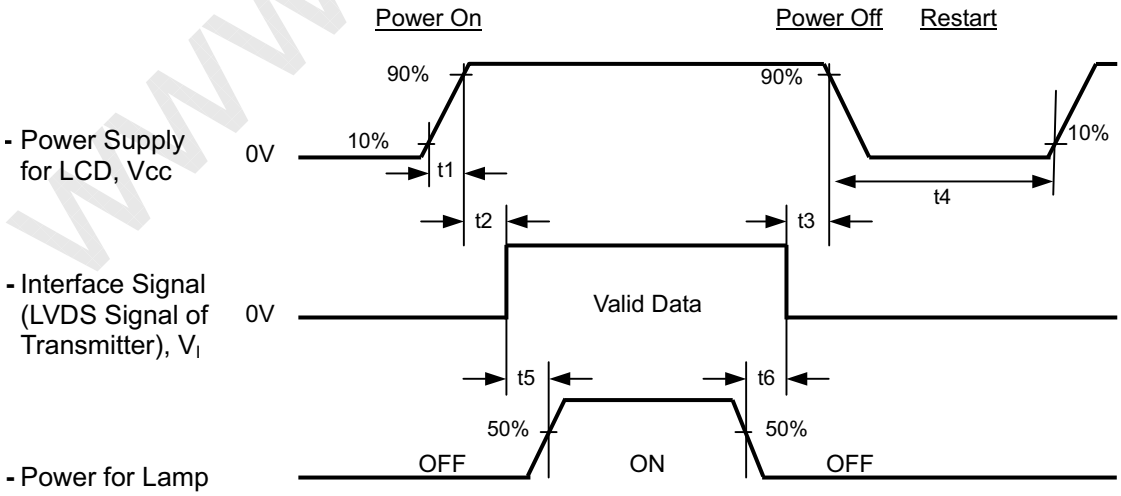
| Signal | Item | Symbol | Min. | Typ. | Max. | Unit | Note |
|---|---|---|---|---|---|---|---|
| DCLK | Frequency | 1/Tc | 50 | 65 | 68 | MHz | - |
| DE | Vertical Total Time | TV | 771 | 806 | 850 | TH | - |
| | Vertical Addressing Time | TVD | 768 | 768 | 768 | TH | - |
| | Horizontal Total Time | TH | 1200 | 1344 | 1600 | Tc | - |
| | Horizontal Addressing Time | THD | 1024 | 1024 | 1024 | Tc | - |

Note (1) Because this module is operated by DE only mode, Hsync and Vsync input signals should be set to low logic level or ground. Otherwise, this module would operate abnormally.

**INPUT SIGNAL TIMING DIAGRAM**




## 6.2 POWER ON/OFF SEQUENCE



Timing Specifications:

t1 <= 10 msec

0 < t2 <= 50 msec

t3 >= 0 msec

t4 >= 150 msec

t5 >= 200 msec

t6 >= 0 msec

t7 <= 10 msec

Note (1) Please avoid floating state of interface signal at invalid period.

Note (2) When the interface signal is invalid, be sure to pull down the power supply of LCD Vcc to 0 V.

Note (3) The Backlight inverter power must be turned on after the power supply for the logic and the interface signal is valid. The Backlight inverter power must be turned off before the power supply for the logic and the interface signal is invalid.

Note (4) Sometimes some slight noise shows when LCD is turned off (even backlight is already off). To avoid this phenomenon, we suggest that the Vcc falling time had better to follow

t7 >= 5 msec

## 7. OPTICAL CHARACTERISTICS

### 7.1 TEST CONDITIONS

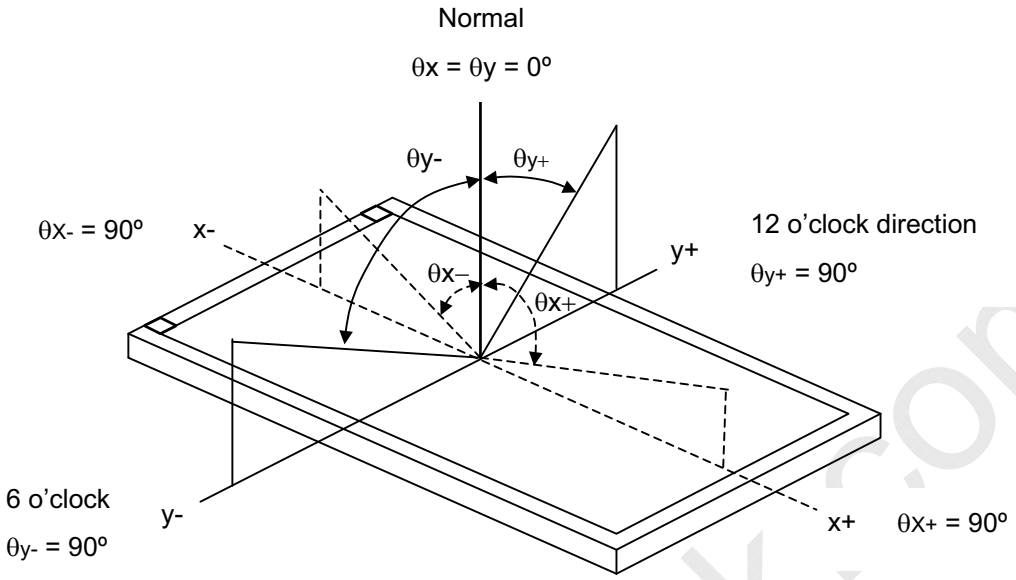
| Item | Symbol | Value | Unit |
|---|---|---|---|
| Ambient Temperature | Ta | 25±2 | °C |
| Ambient Humidity | Ha | 50±10 | %RH |
| Supply Voltage | $V_{CC}$ | 3.3 | V |
| Input Signal | According to typical value in "3. ELECTRICAL CHARACTERISTICS" | | |
| Inverter Current | $I_L$ | 6.0 | mA |
| Inverter Driving Frequency | $F_L$ | 61 | KHz |
| Inverter | Sumida H05 4915 | | |

The relative measurement methods of optical characteristics are shown in 6.2. The following items should be measured under the test conditions described in 6.1 and stable environment shown in Note (6).

### 7.2 OPTICAL SPECIFICATIONS

| Item | | Symbol | Condition | Min. | Typ. | Max. | Unit | Note |
|---|---|---|---|---|---|---|---|---|
| Color Chromaticity | Red | Rx | $\theta_x$=0°, $\theta_Y$ =0° CS-1000T | TYP -0.03 | 0.580 | TYP +0.03 | --- | (1), (5) |
| | | Ry | | | 0.335 | | --- | |
| | Green | Gx | | | 0.314 | | --- | |
| | | Gy | | | 0.534 | | --- | |
| | Blue | Bx | | | 0.151 | | --- | |
| | | By | | | 0.119 | | --- | |
| | White | Wx | | | 0.313 | | --- | |
| | | Wy | | | 0.329 | | --- | |
| Average Luminance of White | | $L_{AVE}$ | | 170 | 200 | --- | $cd/m^2$ | (4),(5) |
| Contrast Ratio | | CR | | 170 | 250 | --- | --- | (2), (5) |
| Color Gamut | | C.G% | | --- | 45 | --- | | (5), (7) |
| Response Time | | $T_r$ | $\theta_x$=0°, $\theta_Y$ =0° | --- | 5 | 10 | ms | (3) |
| | | $T_f$ | | --- | 11 | 16 | ms | |
| White Variation | | $\delta W_5$ | $\theta_x$=0°, $\theta_Y$ =0° CA-210 | 80 | --- | --- | % | (6) |
| | | $\delta W_{13}$ | | 65 | --- | --- | | |
| Viewing Angle | Horizontal | $\theta_x$+ | CR≥10 CA-210 | 40 | 45 | --- | Deg. | (1), (5) |
| | | $\theta_x$- | | 40 | 45 | --- | | |
| | Vertical | $\theta_Y$+ | | 15 | 20 | --- | | |
| | | $\theta_Y$- | | 40 | 45 | --- | | |

Note (1) Definition of Viewing Angle (θx, θy):




Note (2) Definition of Contrast Ratio (CR):

The contrast ratio can be calculated by the following expression.

Contrast Ratio (CR) = L63 / L0

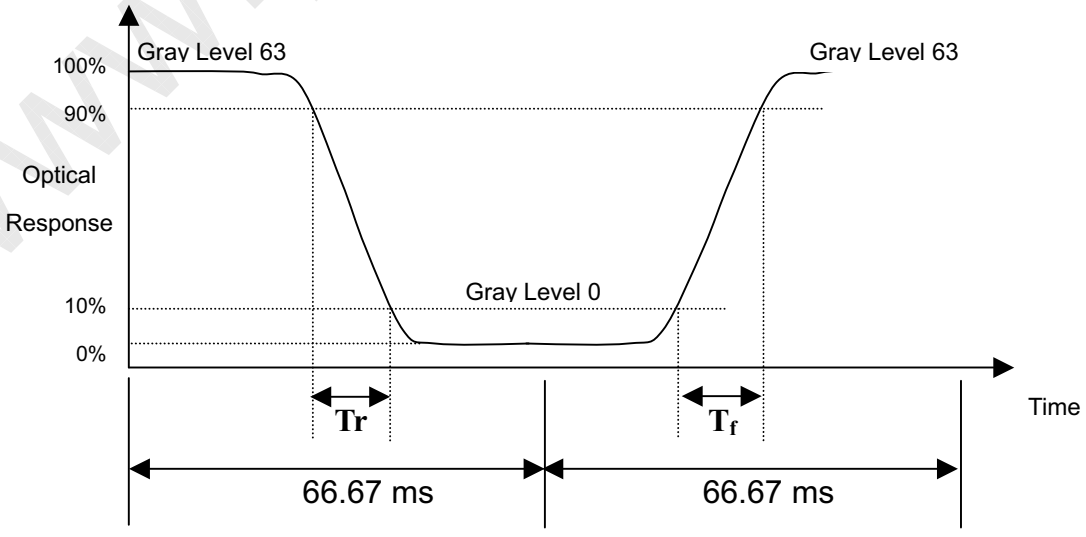
L63: Luminance of gray level 63

L 0: Luminance of gray level 0

CR = CR (1)

CR (X) is corresponding to the Contrast Ratio of the point X at Figure in Note (6).

Note (3) Definition of Response Time ($T_R$, $T_F$):



Note (4) Definition of Average Luminance of White ($L_{AVE}$):

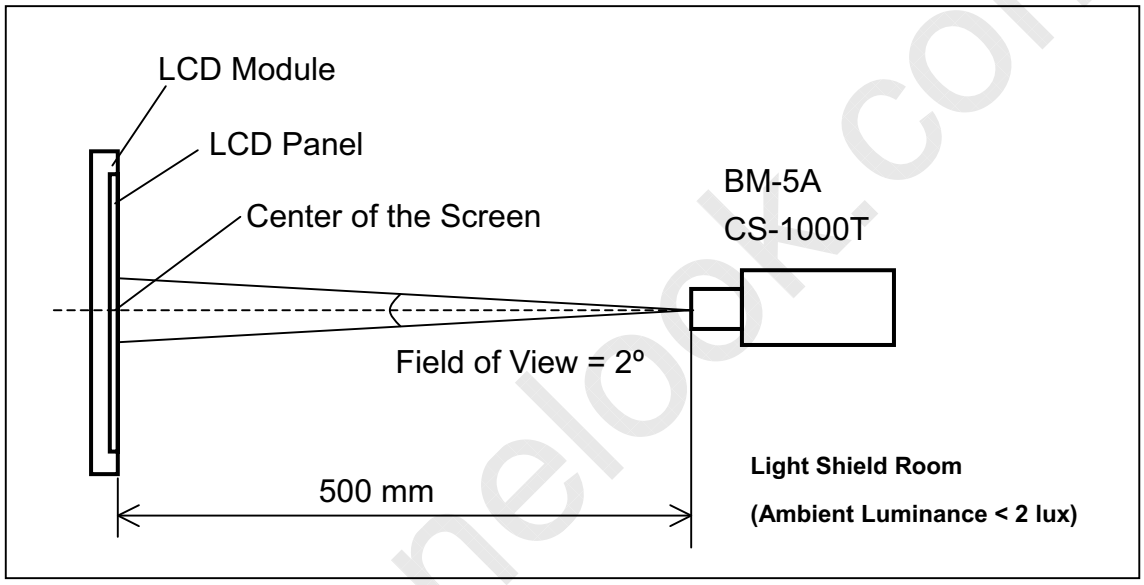
Measure the luminance of gray level 63 at 5 points

$L_{AVE}$ = [L (1)+ L (2)+ L (3)+ L (4)+ L (5)] / 5

L (x) is corresponding to the luminance of the point X at Figure in Note (7).

Note (5) Measurement Setup:

The LCD module should be stabilized at given temperature for 20 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 20 minutes in a windless room.

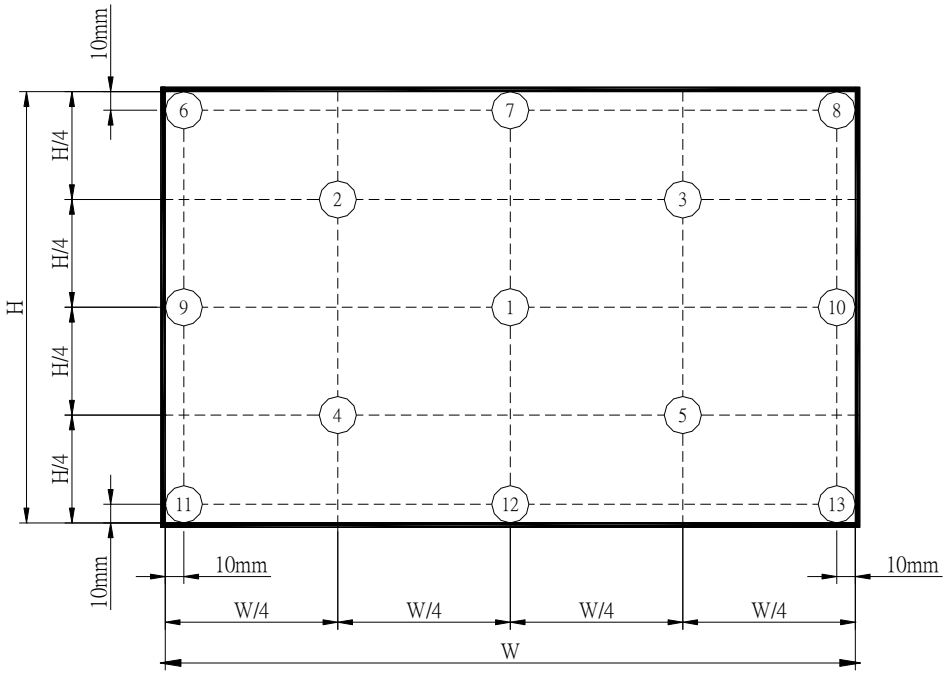


Note (6) Definition of White Variation ( $\delta W_5, \delta W_{13}$ ):

Measure the luminance of gray level 63 at 5 points

$\delta W_5$ = Minimum [L (1), L (2), L (3), L (4), L (5)] / Maximum [L (1), L (2), L (3), L (4), L (5)]

$\delta W_{13}$ = Minimum [L (1), L (2), …, L (12), L (13)] / Maximum [L (1), L (2), …, L (12), L (13)]




Note (7) Definition of color gamut (C.G%):

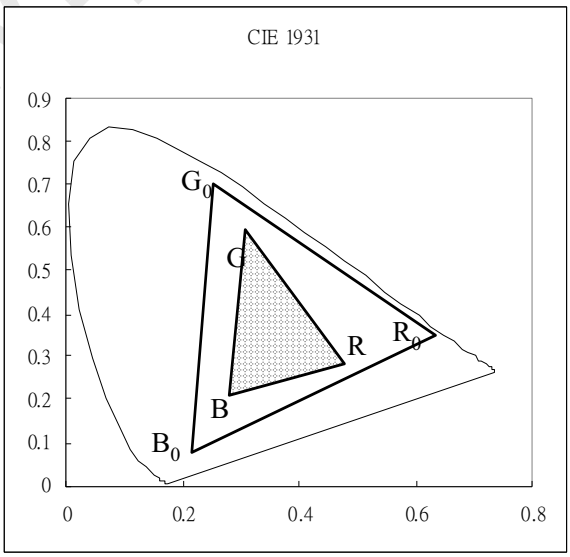
C.G%= $\Delta R\ G\ B\ / \Delta R_0\ G_0\ B_0$,*100%

$R_0, G_0, B_0$ : color coordinates of red, green, and blue defined by NTSC, respectively.

R, G, B : color coordinates of module on 63 gray levels of red, green, and blue, respectively.

$\Delta R_0\ G_0\ B_0$ : area of triangle defined by $R_0, G_0, B_0$

$\Delta R\ G\ B$: area of triangle defined by R, G, B



# 8. PRECAUTIONS

## 8.1 HANDLING PRECAUTIONS

(1) The module should be assembled into the system firmly by using every mounting hole. Be careful not to twist or bend the module.

(2) While assembling or installing modules, it can only be in the clean area. The dust and oil may cause electrical short or damage the polarizer.

(3) Use fingerstalls or soft gloves in order to keep display clean during the incoming inspection and assembly process.

(4) Do not press or scratch the surface harder than a HB pencil lead on the panel because the polarizer is very soft and easily scratched.

(5) If the surface of the polarizer is dirty, please clean it by some absorbent cotton or soft cloth. Do not use Ketone type materials (ex. Acetone), Ethyl alcohol, Toluene, Ethyl acid or Methyl chloride. It might permanently damage the polarizer due to chemical reaction.

(6) Wipe off water droplets or oil immediately. Staining and discoloration may occur if they left on panel for a long time.

(7) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contacting with hands, legs or clothes, it must be washed away thoroughly with soap.

(8) Protect the module from static electricity, it may cause damage to the C-MOS Gate Array IC.

(9) Do not disassemble the module.

(10) Do not pull or fold the lamp wire.

(11) Pins of I/F connector should not be touched directly with bare hands.

## 8.2 STORAGE PRECAUTIONS

(1) High temperature or humidity may reduce the performance of module. Please store LCD module within the specified storage conditions.

(2) It is dangerous that moisture come into or contacted the LCD module, because the moisture may damage LCD module when it is operating.

(3) It may reduce the display quality if the ambient temperature is lower than 10 deg C. For example, the response time will become slowly, and the starting voltage of lamp will be higher than the room temperature.

## 8.3 OPERATION PRECAUTIONS

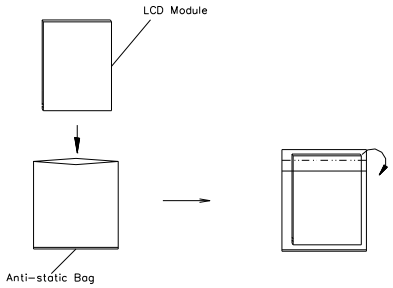
(1) Do not pull the I/F connector in or out while the module is operating.

(2) Always follow the correct power on/off sequence when LCD module is connecting and operating. This can prevent the CMOS LSI chips from damage during latch-up.

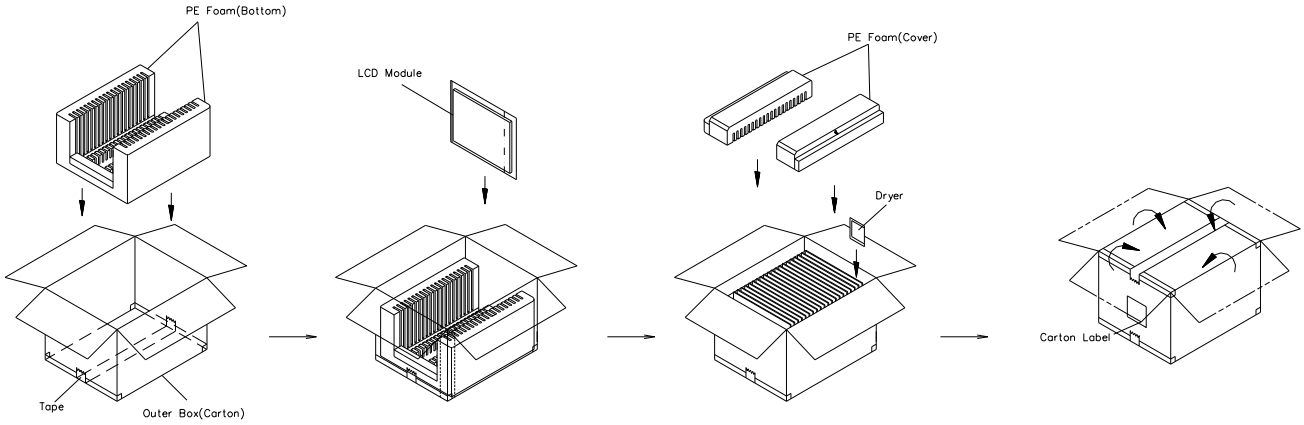
(3) The startup voltage of Backlight is approximately 1000 Volts. It may cause electrical shock while assembling with inverter. Do not disassemble the module or insert anything into the Backlight unit.

## 9.PACKING

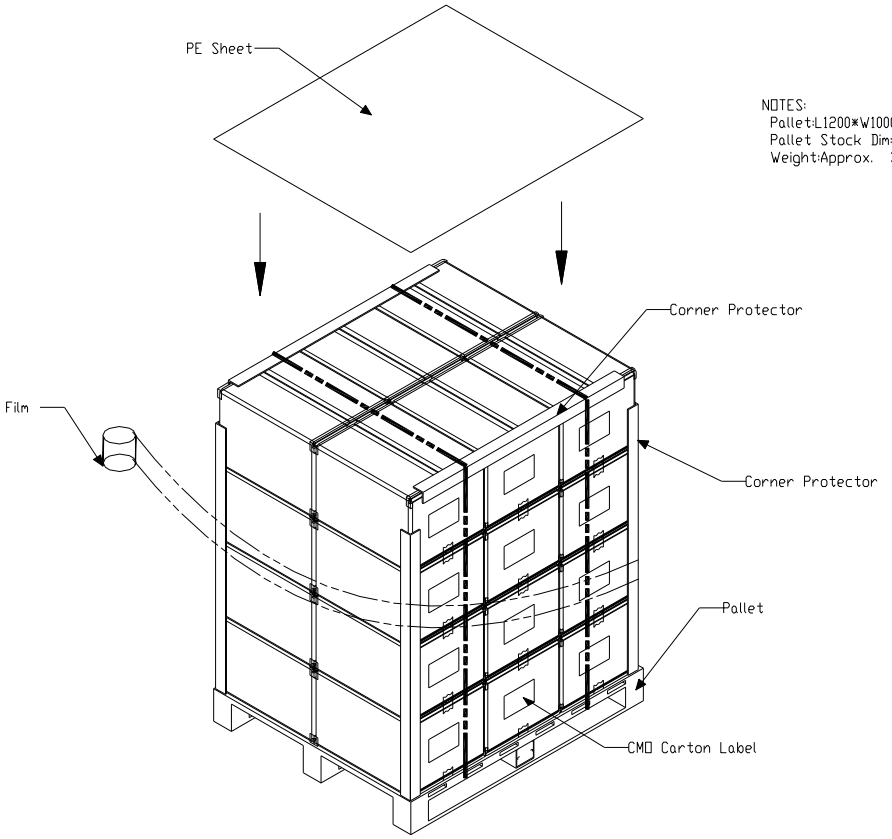
### 9.1 CARTON




Box Dimensions : 500(L)*400(W)*362(H)
Weight: Approx.12.7kg(20 module.per.1 box)



9.2 PALLET



# 10. DEFINITION OF LABELS

## 10.1 CMO MODULE LABEL

The barcode nameplate is pasted on each module as illustration, and its definitions are as following explanation.


(a) Model Name: N150X3 - L0A

(b) Revision: Rev. XX, for example: C1, C2 …etc.

(c) Serial ID: X X X X X X Y M D L N N N N

- Serial No.
- Product Line
- Year, Month, Date
- CMO Internal Use
- Revision
- CMO Internal Use

Serial ID includes the information as below:

(a) Manufactured Date: Year: 1~9, for 2001~2009

Month: 1~9, A~C, for Jan. ~ Dec.

Day: 1~9, A~Y, for 1st to 31st, exclude I , O and U

(b) Revision Code: cover all the change

(c) Serial No.: Manufacturing sequence of product

For Lenovo's barcode content

**11S PPPPPPP Z1Z HHH SSSSSS YMM**

(a) 11S: Fixed characters.

(b) PPPPPPP (P/N): Customer part number 13N7068, fixed characters

(c) Z1Z: Fixed characters.

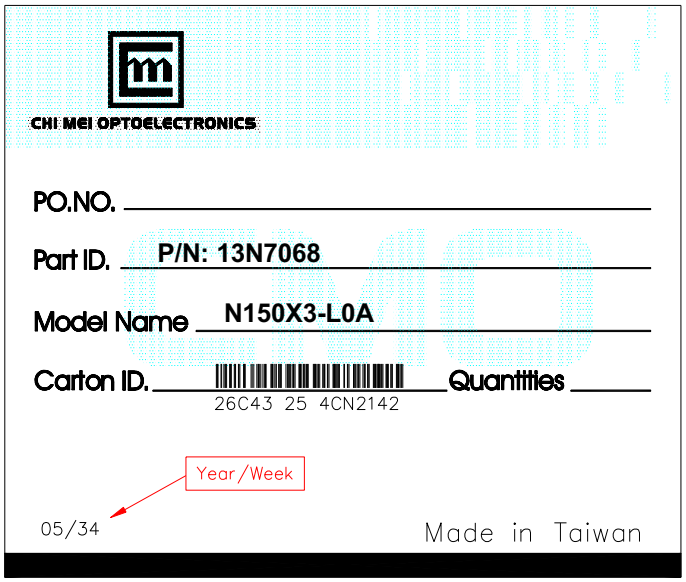
(d) HHH (Header Code): ABX

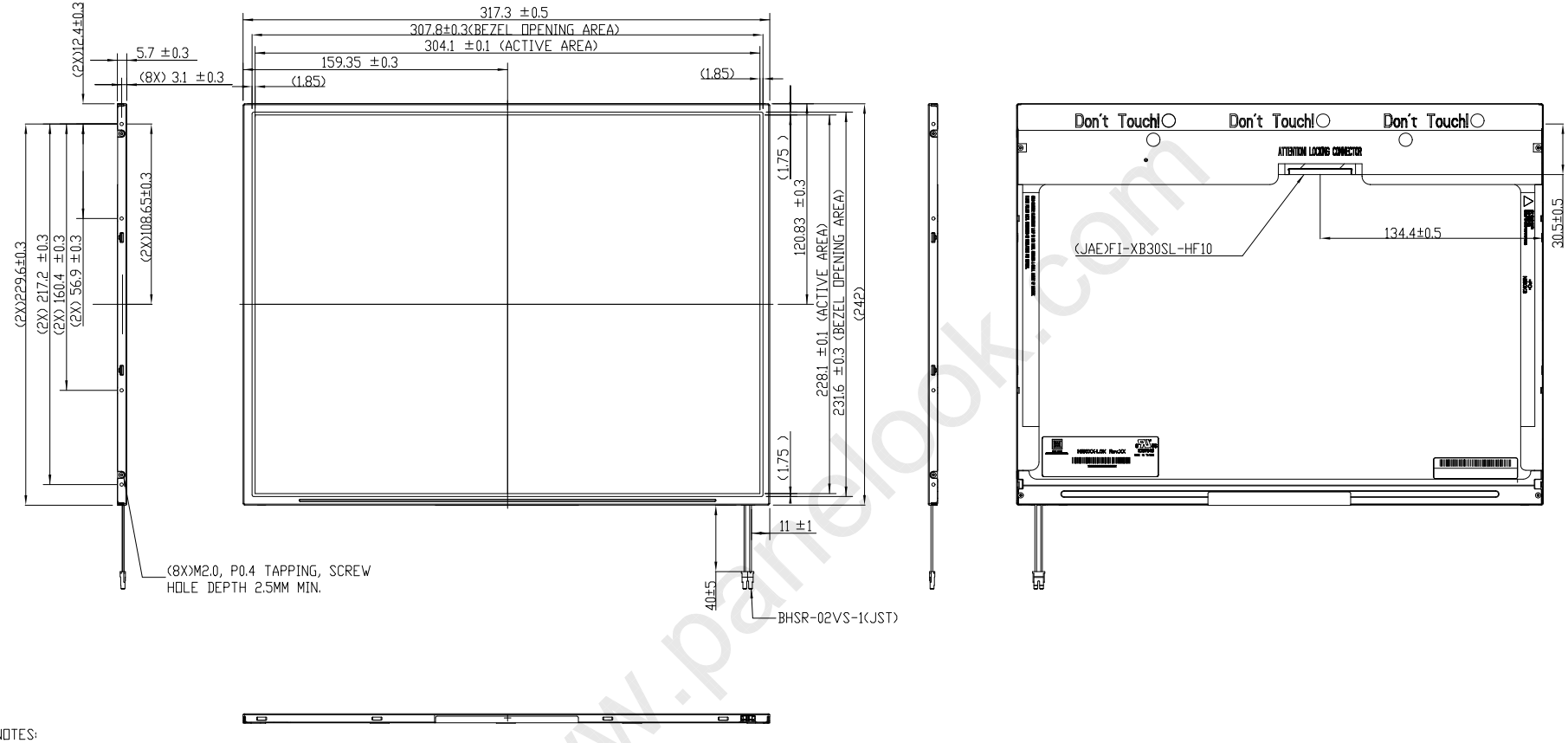
(e) SSSSSS: Series number.

(f) YMM: Y: The last character of year.

MM: Month

10.2 CARTON LABEL






NOTES:
1.SCREW HOLE DEPTH 2.5MM MIN.
2.MAX.SCREW TORQUE:2.5 kg-cm.

| Mark | Description | Date | Changed_By | Approved_By | ECN No. | Remark |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |
| | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| TITLE | OUTLINE_N150X3-L0A | | | | | 2D REV. | 2 |
| | | | | | | 3D REV. | 1 |
| Approved | BILL SHEU | Drawing No. | N150441602 | | | | |
| Checked | YULE LIN | Part No. | | | | | |
| Drawer | YAO CHIEN | Material | | | Sheet | 1 / 1 | A3 |
| Designer | YAO CHIEN | Date | 11-Apr-2005 | Scale | 1:2 | Unit:mm | |

CHI MEI OPTOELECTRONICS CORP.